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Light Reactions in Lower Organisms. I. *Stentor cœruleus.* S. O. Mast. *Journal of Experimental Zoology,* Vol. III., No. 3, 1906. Pp. 359–399. II. *Volvox.* S. O. Mast. *Journal of Comparative Neurology and Psychology,* Vol. XVII., No. 2, 1907. Pp. 99–180.

These two papers are characterized by the intensive, detailed methods employed by the author in his study of the reactions to light of two familiar lower organisms. Special attention and care were given to determining the direction and intensity of light falling upon the animals while they were in the experiments, in other words, to the regulation of the stimulus. The results with stentor are for the most part confirmatory, though obtained independently, of those obtained by Jennings upon the same organism. The light reactions of volvox had previously been considered in some detail by Holmes, with whose conclusions the present author takes a number of exceptions.

The observations upon stentor are divided under three main headings, viz., those upon moving stentors, upon attached stentors, and upon the threshold for light stimuli. The responses of stentor to light fall in line with the behavior of the protozoa in general, orientation and a course away from the light being brought about by motor reactions, which are repeated until the animal is in the position of least stimulation. This is attained when the anterior end is directed away from the source of light. The motor reaction is induced by an increase of illumination, whether this is caused by a change in the animal's position relative to the light, or by an actual increase in the intensity of the light itself.

Attached stentors do not orient to the direction of the light, largely because the tendency to maintain a position perpendicular to the surface to which they are attached overcomes the tendency to orient with reference to the light. Furthermore, the threshold for light stimuli is much higher in attached stentors. In free-swimming individuals the minimum threshold for animals stimulated by rays perpendicular to the longitudinal axis is 1.2 candle-meters, but in those stimulated by light striking the anterior end it is only 0.25 candle-meter. There is considerable variation in the threshold, the animals becoming readily acclimated to a given intensity.

The author's statement (p. 392) that "stentors once oriented remain oriented, if the light intensity is not too high, because they are least sensitive to light when the rays strike the posterior end," does not seem satisfactorily explained if we accept his conclusion that the motor reaction is the only means by which orientation is brought about and maintained. According to the motor-reaction precept, the light has no effective action until it has increased in intensity to the threshold increment, when a motor reaction is induced, which either places the organism again in orientation, or is repeated until that relation is attained. It is certainly not probable that stentor, once oriented and moving in a straight line from the light, can maintain that direction without some external directive force acting upon it to keep it oriented. If the motor reaction is not the factor which brings about this result, it would seem that there must be some other means by which stentor responds to changes in light intensity less than the threshold which causes the motor reaction, so that when it begins to swerve from the proper alignment it is brought back again before it has gone so far that the motor reaction is induced. Will this part of the results have to be explained after all by something similar to the much despised "tropism theory"?

The first part of the paper on volvox is concerned with the structure and natural history of this interesting organism. Among other things the author states that "the eye-spots in volvox are located on the outer posterior surface of the individuals of which the colonies are composed, not on the outer anterior surface, as represented by Overton." A detailed and careful study of the method of locomotion and an analysis of the factors which bring about orientation are then made. Three of the sections in the author's summary embody the conclusions which are perhaps of most general interest. These are as follows (p. 178):

"The direction of motion in volvox is regulated by the relative light intensity on opposite sides of the colony, regardless of the ray direction."

"Orientation is not the result of 'trial and error' reactions as in stentor, euglena and other forms. Volvox colonies make no errors in this process."

"There is no evidence of motor reaction in a volvox colony, taken as a whole. Orientation is, however, brought about by motor reactions in the individuals which constitute the colony. If opposite sides of a colony are unequally illuminated, the individuals in the colony continually pass from regions of higher to regions of lower light intensity, and *vice versa,* as the organism rotates. This change in light intensity induces motor reactions in the individuals, which result in orientation of the colony. The motor reaction in positive specimens is induced only when the intensity to which the zooids are exposed is decreased, and in negative colonies only when it is increased."

We find, then, that the orientation of volvox is really a secondary result brought about by the independent reactions of the individuals of which it is composed. Although a definite result is obtained, the only coordination between the individuals is one due to the positional relation which they bear to one another and to the colony as a whole with respect to the light. This may, perhaps, be an additional reason for considering the volvox spherule a colony of individuals, and not an individual in itself.

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JOURNALS AND NEW BOOKS

RIVISTA FILOSOFICA. January–February, 1907. *La funzione religiosa della filosofia* (pp. 3–35): P. MARTINETTI. – The function of philosophy is to promote through knowledge the supreme interests of life. Philosophy discards mythical elements. Philosophy, in its struggle with traditional faith, is not negative, but reconstructive. The positive result